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This document has been prepared in partial fulfillment of CDPL line item A004 of System Development Corporation's Air Force Global Weather Central System Architecture Study contract. Efforts for this report were expended under Task 6, "Conceptual Design and Development Plan", performed under contract F04701-75-C-0114 for SAMSO, under the direction of Col. R. J. Fox, YDA.

The purpose of this study has been to optimize the entire AFGWC data process-

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ing system from the vantage point of current and future support requirements, addressing the AFGWC data processing system over the 1977 through 1982 time frame. This study was performed under a unique plan which allows complete traceability between user requirements, Air Force Global Weather Central operational functions, requirements levied upon the data system, a proposed component configuration which meets the data system requirements, and a system specification designed to acquire a system which meets these requirements.

The resultant system described has a number of unique features, including total hardware authentication separation of security levels, load leveling accomplished by assigning main processors in accordance with a dynamic priority queue of tasks, and a system-wide network control capability. Other key features include a central data base processor to fill requests for data from other processors, computer operations centers, the use of array processors for accomplishing difficult numerical problems, and sophisticated forecaster console support. These elements have been designed to provide 99.5% reliability in meeting user requirements.

The proposed system architecture consists of five dual processors each of which is about 3.5 times as powerful as an existing AFGWC processor (a Univac 1108). Each dual processor has an array processor which will be capable of very high performance on vector arithmetic. The array processors are used to assist on the difficult numerical problems, including the Advanced Prediction Model for the global atmosphere, as well as very fine grid cloud models and cloud probability models. Some of the new requirements that will be supported with this system are a one minute response to query interface, reentry support for Minuteman, and limited processing of high resolution (0.3 nautical mile) meteorological satellite data. In addition, cloud cover prediction for tactical weapon systems, ionospheric prediction for radio frequency management, and defense radar interference prediction will be supported by this system.

Volumes of this final System/Subsystem Summary Report are as follows:

Volume 1 - Executive Summary

Volume 2 - Requirements Compilation and Analysis (Parts 1, 2, and 3)

Volume 3 - Classified Requirements Topics (Secret)

Volume 4 - Systems Analysis and Trade Studies

Volume 5 - System Description

Volume 6 - Aerospace Ground Equipment Plan

Volume 7 - Implementation and Development Plans

Volume 8 - System Specification

System Development Corporation

AIR FORCE GLOBAL WEATHER CENTRAL

SYSTEM ARCHITECTURE STUDY

FINAL SYSTEM/SUBSYSTEM SUMMARY REPORT

VOLUME 2

REQUIREMENTS COMPILATION AND ANALYSIS

PART 2

FUNCTIONAL DESCRIPTION

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PART 2

ABSTRACT

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Volume 8 - System Specification

This volume consists of three separately bound parts, with each part oriented towards specific areas covered in Task 1. Part 1 includes user requirements analyses in Section 1.0 that summarize the impact of current and new requirements on the proposed architecture. Part 1 also contains descriptions of proposed new models for the 1977-1982 time period in Section 2.0, with emphasis on data processing requirements.

In Part 2, this volume contains detailed descriptions of current and future functional characteristics of AFGWC in Section 3.0.

In Part 3, an in-depth network analysis (Section 4.0) that depicts various key interrelationships between these functions is presented. This network analysis has been instrumental in leading to the determination of processing capability that is required of this new architecture.

Another important analysis that has led to the determination of data system parameters has been the Task 1 data system characteristics summarization effort. This activity involved the compilation of a wide variety of important data system parameters across functional areas, eventually leading to the establishment of component values of the architectural domain in subsequent tasks. Results are summarized in Part 3, Section 5.0. The extensive working papers generated in this compilation process have been provided under separate cover.

SDC has also compiled a presentation of several topics involving growth, maintainability, and other aspects of general system performance. These topics appear in Part 3, Section 6.0.

Finally, SDC has compiled extensive glossaries of the terms and abbreviations encountered and used in this study. These glossaries include the abbreviations encountered in assessing user requirements (described in Section 1.0), plus many others emanating from AFGWC, technical literature, and other sources, and are included after Section 6.0 in Part 3 of this volume.

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RELATIONSHIP OF VOLUME STRUCTURE TO DOMAINS

This part of Volume 2 describes present and planned functional requirements for the AFGWC data system. As such, the content of this document is based on the structure of the Functional Domain. First, the function descriptions are ordered in direct accordance with the structure of this domain. Topics are discussed as subdivisions under the following major areas:

- F1000: Input Processing Functions,
- F2000: Data Base and Related Computations Functions,
- F3000: Output Processing Functions,
- F4000: Support Processing Functions.

In Section 3.2, this same functional categorization is used, next, to provide step-by-step detail of the sequential steps used to perform several key functions within this domain. These detailed procedures have been assembled to provide additional insight into AFGWC data system requirements through the analysis of data processing operations at a functional level.

APPLICABLE DOMAIN VS. PAGE NUMBERS

*Page number of general functional area description and/or detailed functional procedures

F4634 Flight Plan Control

F4635 SESS

F4636 Classified and Misc.

F4640 Program Storage

VOLUME/DOMAIN RELATIONSHIPS

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*See Part 1 of this volume for descriptions of requirements

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3.0 FUNCTIONAL DESCRIPTION

This section depicts the major operational functions employed at AFGWC to support user requirements. These functional areas are categorized as follows:

a. Input Data Processing,

b. Data Base and Related Computations,

c. Output Processing, and

d. Support Processing.

Subcategories describe current operations, as well as new functions that will be implemented in the 1977-82 time period. This information is depicted graphically on Figures 7 through 10, and is summarized for major functional areas on the pages that follow. More detailed information on a number of selected key functional areas is also presented.

3.1 FUNCTION DESCRIPTIONS

3.1.1 Input Processing Functions

3.1.1.1 SESS (F1100)

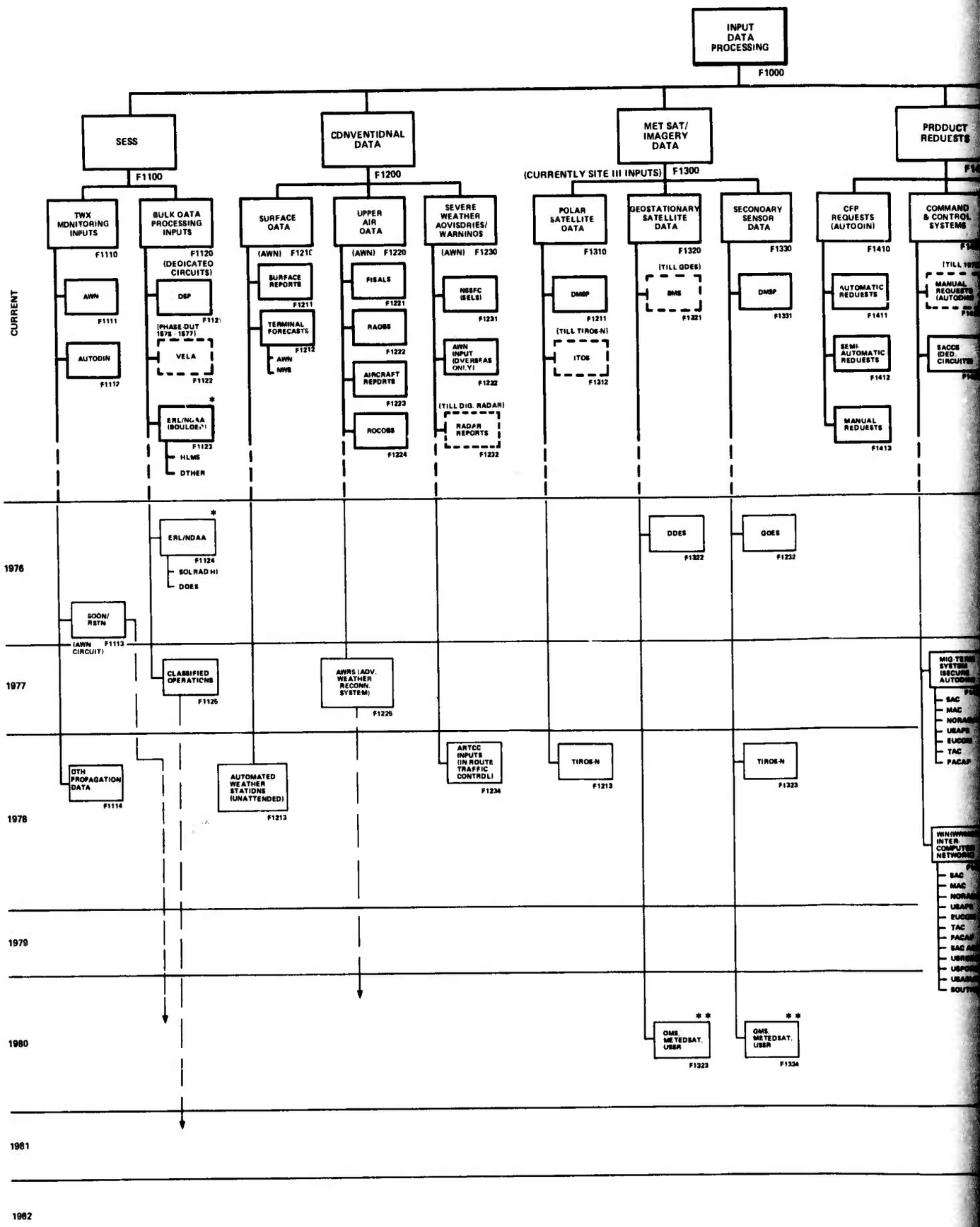
Space environmental support system data enters AFGWC from these primary sources:

a. Astrogeophysical Teletype Network (ATN) messages which are routed from ATN stations to Carswell for input to AFGWC on the AWN line,

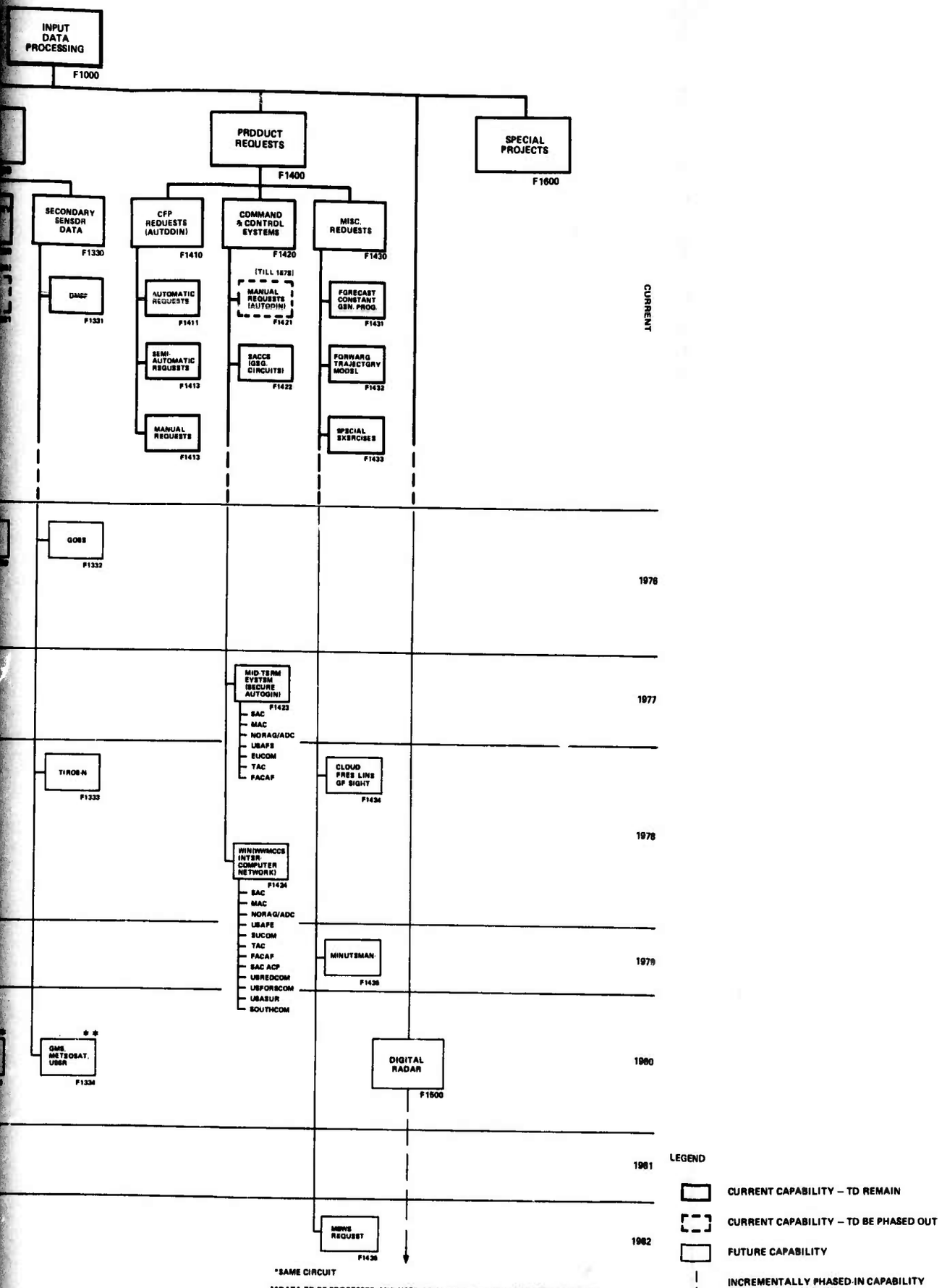
b. NOAA messages over a dedicated circuit, and

c. DSP messages over a dedicated circuit.

FIGURE 7. INPUT DATA PROCESSING FUNCTIONS



CESSING FUNCTIONS



*SAME CIRCUIT

**DATA TO BE PROCESSED AND USED AS AVAILABLE WITH MINIMUM RESOURCE EXPENDITURE. LOW PRIORITY INFLUENCE ON ARCHITECTURE STUDY.

FIGURE 8. COMPUTATIONAL FUNCTIONS

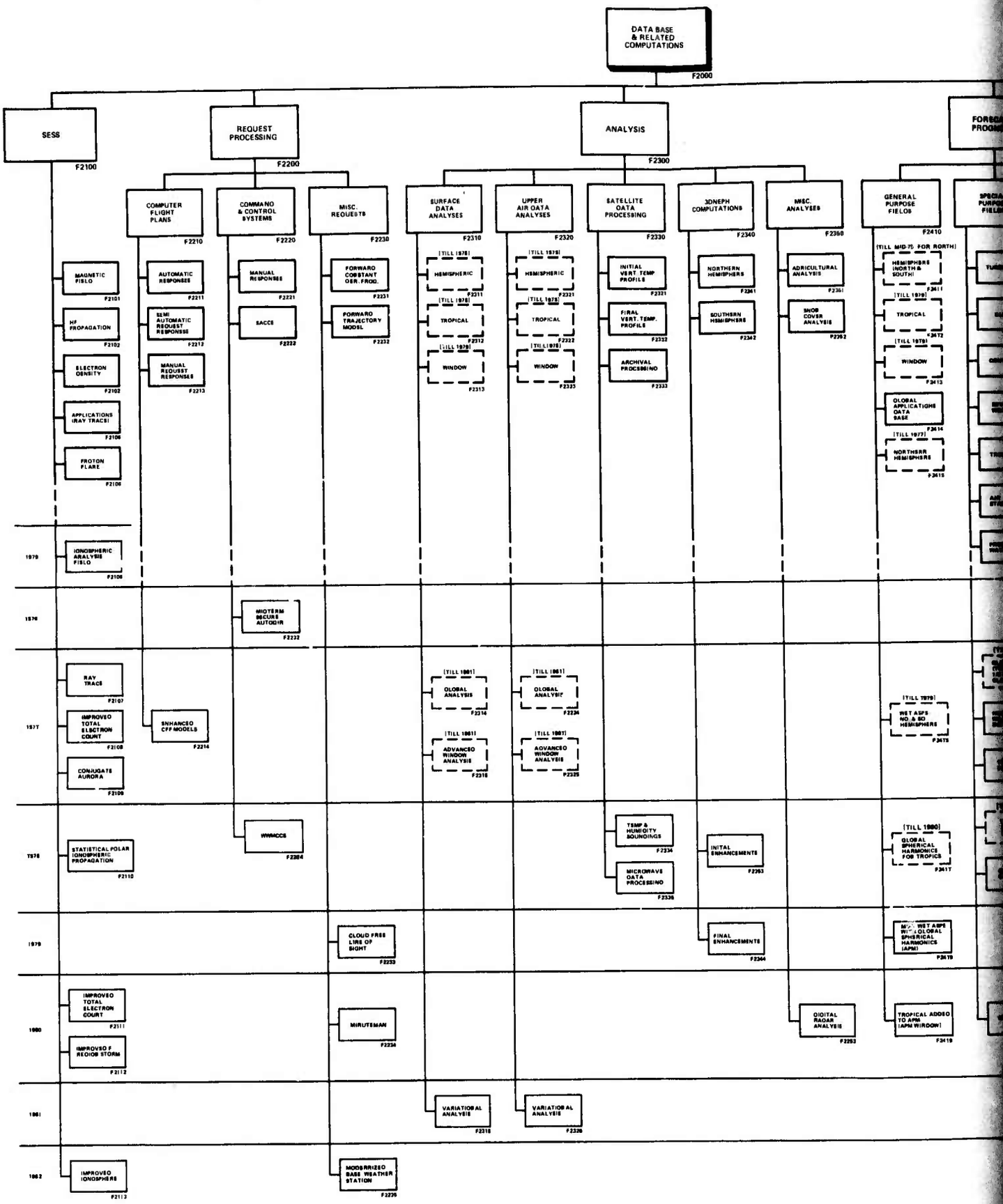


FIGURE 8. COMPUTATIONAL FUNCTIONS

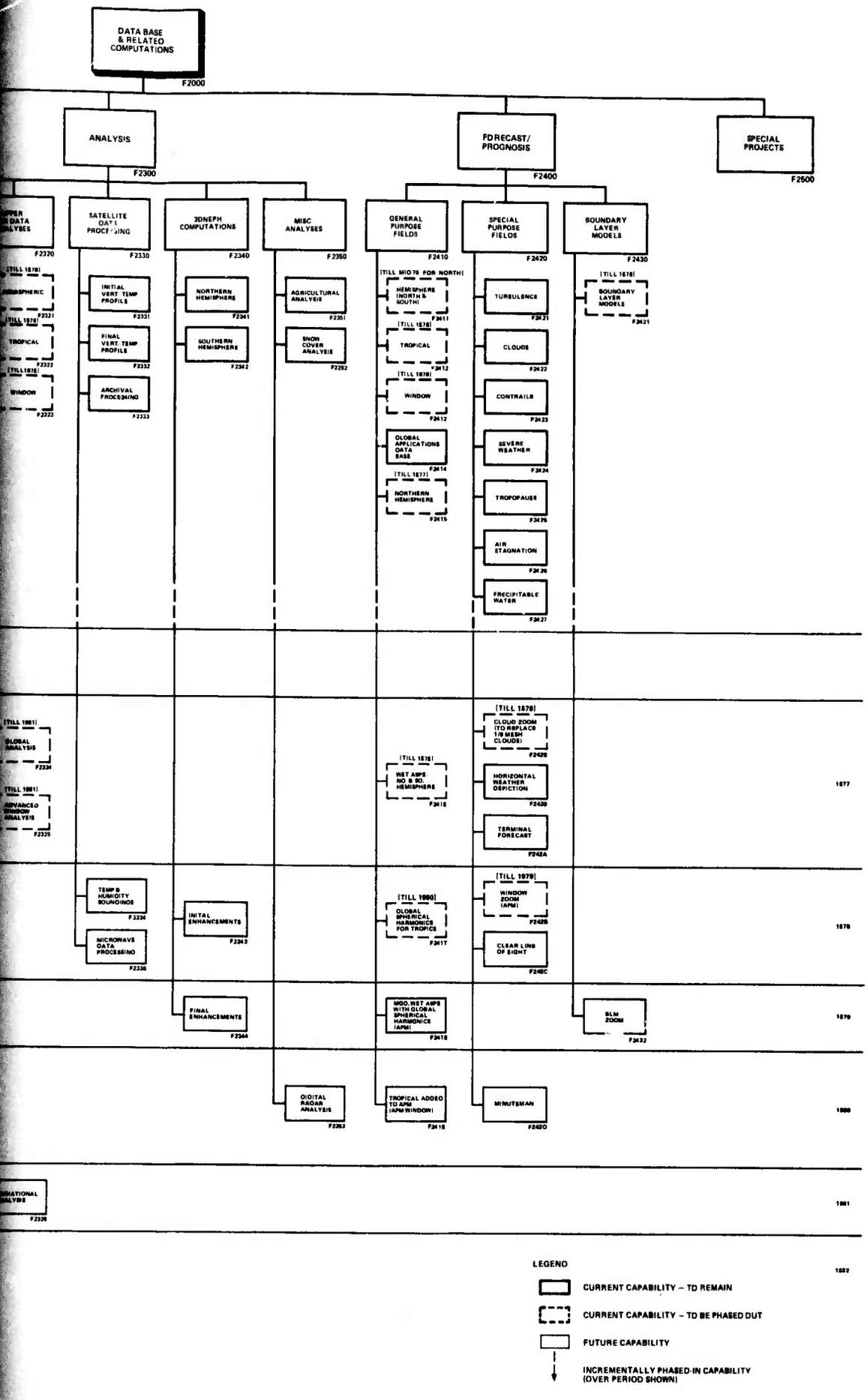
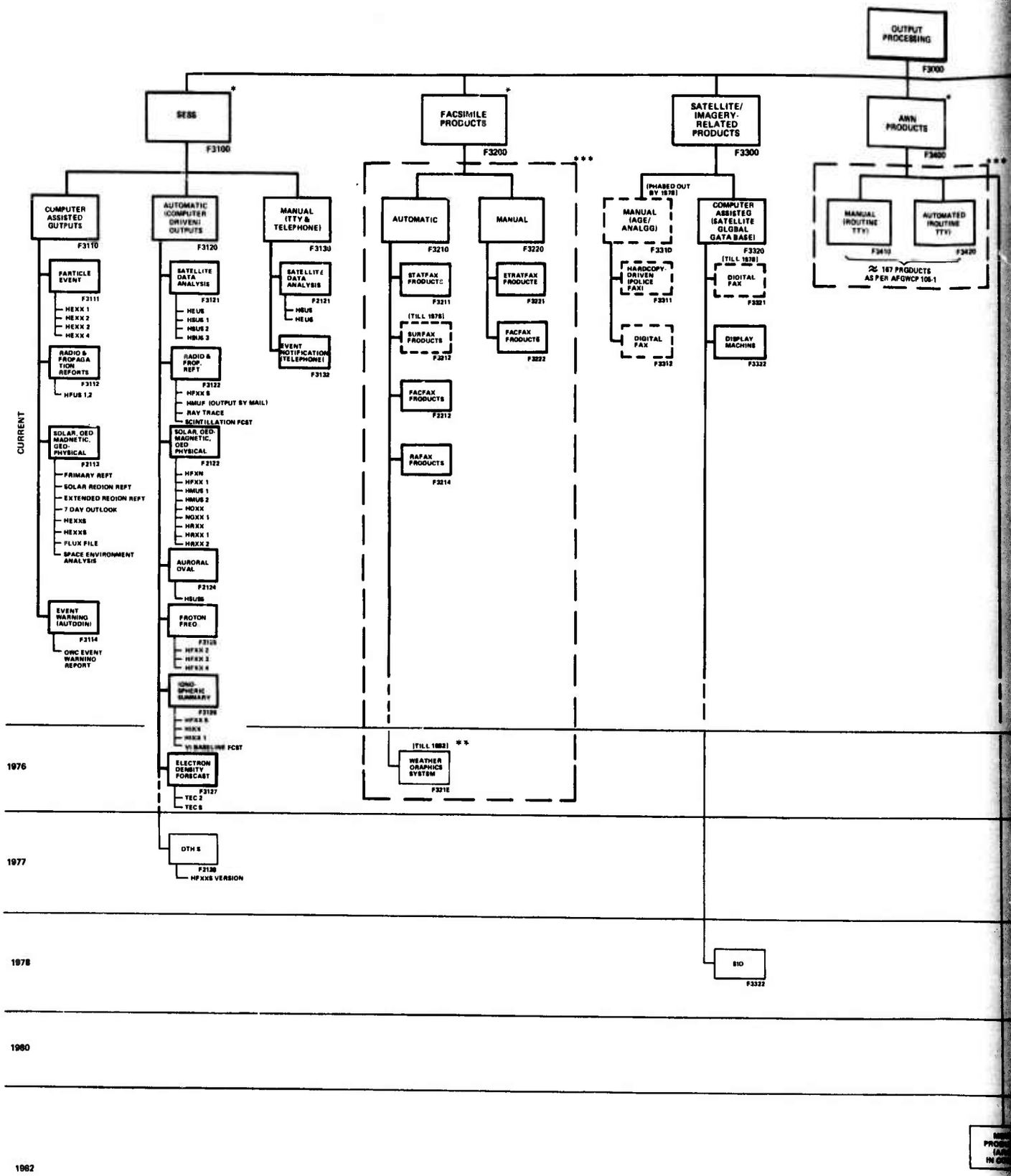
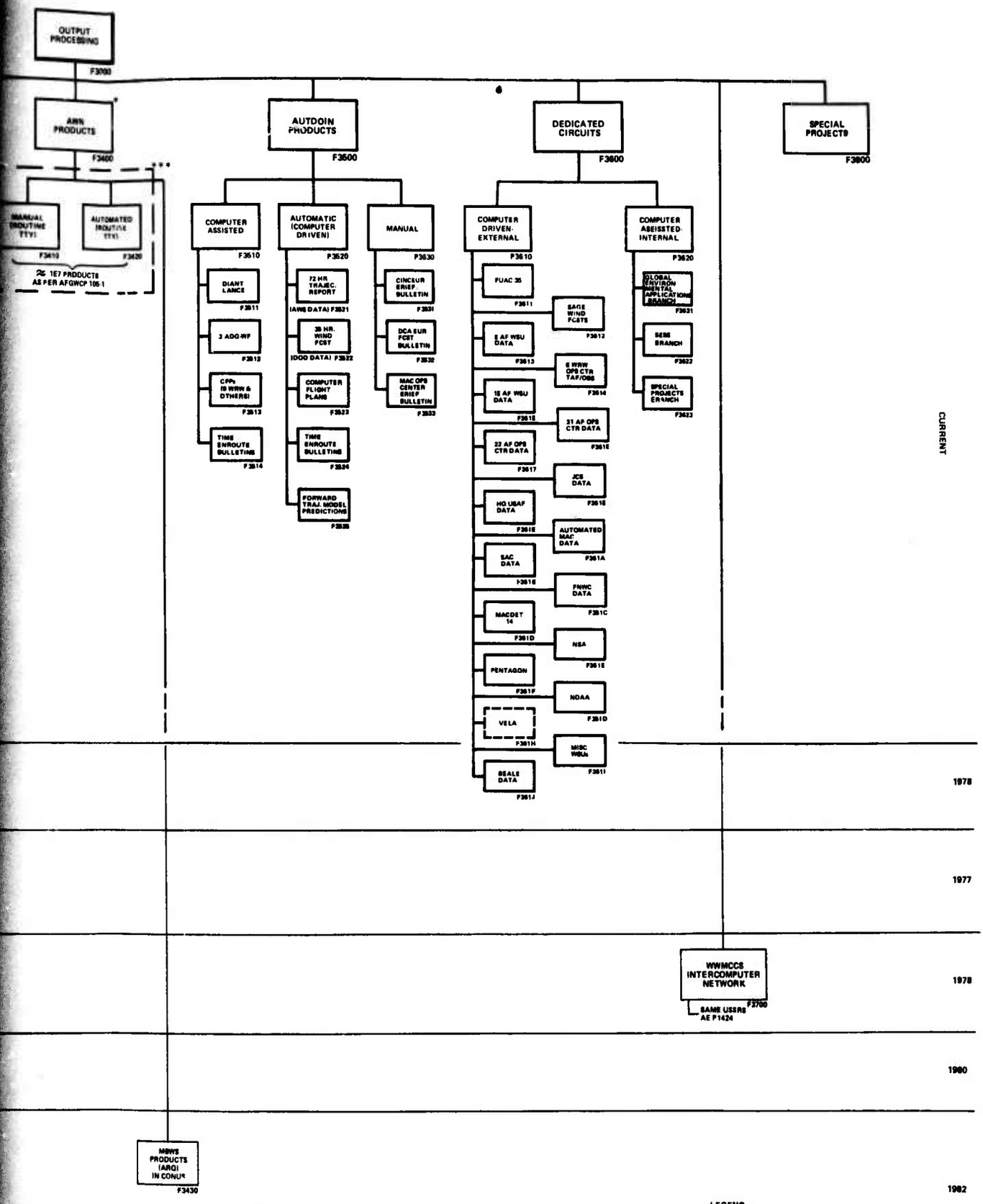


FIGURE 9. OUTPUT PROCESSING FUNC



UTPUT PROCESSING FUNCTIONS

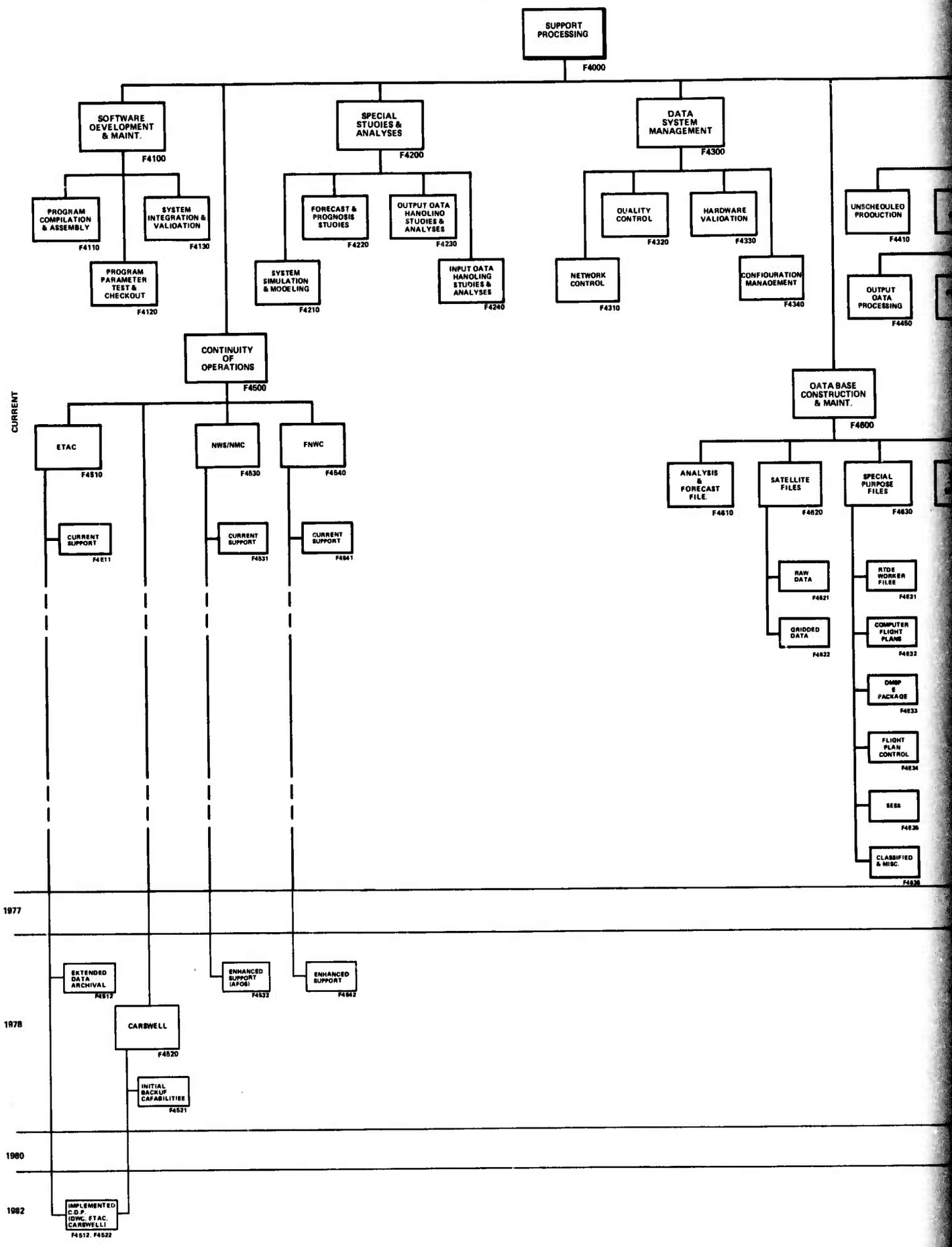


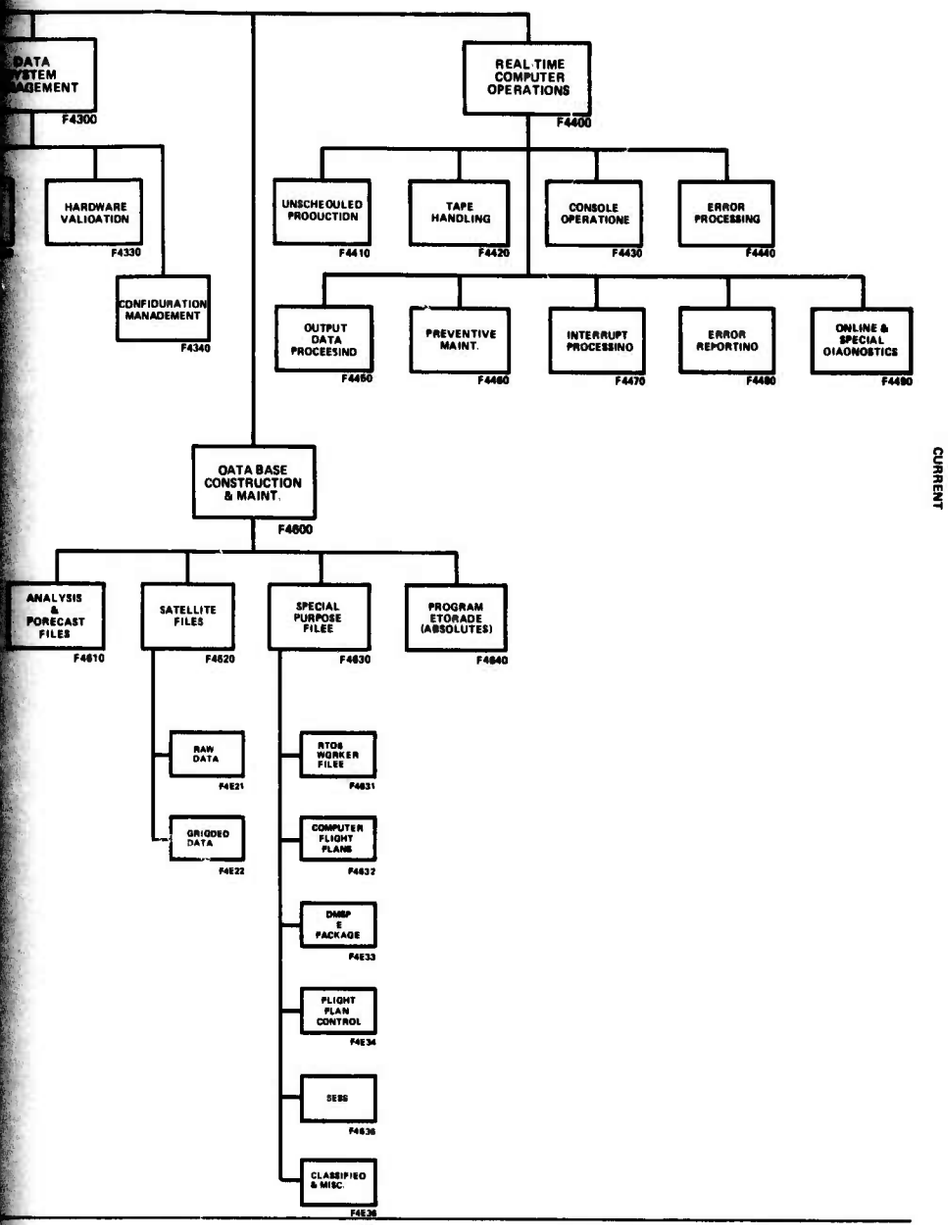
* CURRENTLY VIA CARSWELL AFWE (EXCEPT AE NOTED)

** REPLACES EURPAX AS INTERIM TO MSWS

*** COMPLETE FUNCTIONS TO BE INCLUDED IN MSWE, APDS, & SIO BY 1984

FIGURE 10. SUPPORT PROCESSING FUNCTIONS





CURRENT

1977

1978

1980

1982

LEGEND

- CURRENT CAPABILITY – TO REMAIN
- CURRENT CAPABILITY – TO BE PHASED OUT
- FUTURE CAPABILITY
- INCREMENTALLY PHASED-IN CAPABILITY (OVER PERIOD SHOWN)

There is also an alternate route from Carswell directly to a SESS teletype at AFGWC, bypassing all computational components for immediate dissemination of significant solar phenomena. This line is the responsibility of the 1911th Communications Squadron. All SESS input data are unclassified, and are decoded, validated, and stored in the data base for eventual access by SESS computation functions.

3.1.1.2 Conventional Data (F1200)

Conventional data inputs consist of surface data, upper air data, and severe weather advisories/warnings. All such data are currently received on the AWN line from Carswell. In 1977 and 1978, new inputs will include surface data from unattended Automated Weather Stations, upper air data from the Advanced Weather Reconnaisance System, and severe weather advisories from Air Route Traffic Control Centers. However, it is expected that these additional inputs will have a small effect on AFGWC, and will also be input via AWN. Conventional data will all be unclassified.

3.1.1.3 METSAT/Imagery Data (F1300)

These inputs currently enter AFGWC at the Site 3 ground station, and now consist of primary and special sensor data from the DMSP satellites. Primary and secondary data from the GOES satellite is expected in 1976 (through its own AFGWC ground station), and similar data is expected from TIROS-N in 1978 (also through a dedicated ground station).

3.1.1.4 Product Requests (F1400)

Product request inputs involve a wide variety of classified and unclassified inputs, encompassing CFP requests, command and control system requests, and numerous types of miscellaneous inputs. Unclassified requests over AWN and dedicated circuits will be decoded, routed, validated, and temporarily stored

the same as SESS and conventional data described earlier, and will use the same kind of equipment. The current AUTODIN line (which can carry messages up to Top Secret level) will eventually be phased out in favor of AUTODIN II, which will have a Top Secret capability, and which will enter AFGWC through a Datanet 355. Other Secret and Confidential inputs will be routed through devices of the appropriate classification level, and subsequent validation and storage will be processed in a manner similar to unclassified data.

3.1.1.5 Digital Radar (F1500)

Digital radar inputs (planned for 1980 implementation) will enter AFGWC on an unclassified high speed dedicated line. It is assumed that 105 current TAF locations will be the sites for AWS digital radars. For effective collection and preprocessing, it is assumed that about 4 "preprocessing" sites will accept data from about 25 radars each (plus several radars from NWS), performing extensive compression of site inputs to eliminate the transmission of useless data to AFGWC. These preprocessing sites could communicate with AFGWC by uplinking to a communications satellite, with a single downlink from this vehicle to AFGWC.

Data rates are expected to be about 2×10^5 bits/second to AFGWC for 4 seconds (one second from each of the four regional sites), with this rate occurring as often as every 15 minutes under severe weather conditions. These data should be sent in virtual real time for maximum utility; therefore, no more than one second should be allowed for the data from each processor site. This infers a 200 kilobit uplink capability to the communications satellite from each preprocessing station and a 200 kilobit downlink to AFGWC.

3.1.1.6 Special Projects (F1600)

Input communications processing for Special Projects will follow the same basic type of data handling scheme indicated for SESS, Conventional Data, and Product Requests.

3.1.2 Data Base and Related Computations Functions (F2000)

3.1.2.1 SESS (F2100)

SESS functions run the gamut of security classifications. Input processing will trigger computational models for both analysis and forecasting algorithms. These execute on main processors and will retrieve from and store into the data base. Most jobs run at scheduled times, but some are event dependent and impossible to schedule in advance, and therefore are initiated as batch runs.

3.1.2.2 Request Processing (F2200)

Typically, the request processing function will involve computer flight plans or related trajectories. The classification of such requests could run anywhere from Unclassified to Top Secret. Requests will be routed to a main processor where necessary computations will be performed. The central data base will be accessed for new and climatological data as well as archived records and libraries, and the result will be routed back to the requestor. Although most requests are more apt to be made at certain hours of the day, they are essentially random and require short reaction times.

3.1.2.3 Analysis (F2300)

The bulk of the computer power at AFGWC can be considered to be dedicated to functions classified as general analysis and forecasting. Almost all these routines can be scheduled far in advance. The models involved in analysis (as well as forecasting) will retrieve from and store into the data base and, when security dictates, make use of classified overlays to the data base.

3.1.2.4 Forecast/Prognosis (F2400)

See section 3.1.2.3 above.

3.1.2.5 Special Projects (F2500)

Jobs associated with the Special Projects Branch run at a special access security level. Jobs will be equally divided between those that are scheduled and those that are more or less random. Most have a high priority and require a fast reaction or minimal deviation from scheduled completion time.

3.1.3 Output Processing Functions (F3000)

3.1.3.1 SESS (F3100)

Space environmental support output products consist of a wide variety of unclassified event warning messages and analysis summaries which are transmitted over dedicated lines to NORAD, MAC, SAC, and other customers. Messages are also transmitted to ATN operating locations through the Carswell link. Data messages can be automatically generated, or they can be assembled by a combination of computer-driven techniques and manual procedures.

SESS output processing will consist of the accessing of SESS messages which have previously been assembled by appropriate conventional routines and stored in the data base. Extraction will be via a main processor, which will pull formatted information from the data base in accordance with runstream, operator, or forecaster commands and pass this information on for transmission over appropriate circuits.

3.1.3.2 Facsimile Products (F3200)

AFGWC will transmit a wide variety of digital and analog facsimile products over STRATFAX, PACFAX, and RAFAX circuits, and will also send digital charts over the Weather Graphics System to European subscribers. In addition, AFGWC will continue to provide backup support to the NWS on NAFAX and NAMFAX networks with analog facsimile products until AFOS becomes operational, when the National Distribution Circuit will be used to support NWS.

To accommodate total automation from a centralized CONUS weather facsimile facility, AFGWC will eventually use minicomputers (similar to the Interdata Model 50) of the same type that NWS is employing at the National Meteorological Center (NMC). The ID Model 50 will be hereafter referred to as the WFSC. The WFSC will replace the manual facility at Offutt AFB, Nebraska, and Suitland, Maryland. The WFSC will receive digitized weather facsimile maps from both the Suitland NMC and AFGWC. The maps/charts will be relayed to users on a predetermined schedule. The WFSC will be a store and forward system whose products will be received in digital form from the data base and converted to an analog signal compatible with customer facsimile recorders. A Keyboard Video Display Terminal (KVDT) will be used for monitoring system performance. It will allow operators to control and alter facsimile schedules. A teletype device will be used to provide a permanent record of data transmitted and received by the WFSC. An intermediate storage device (disk) can be used for map storage. The WFSC will also receive manually drawn charts. These charts will be digitized and stored on the intermediate storage device. A schedule of transmission requirements can also be kept on the disk, and schedules can be executed automatically under program control.

3.1.3.3 Satellite/Imagery-Related Products (F3300)

The Satellite Imagery Dissemination (SID) system will provide satellite imagery data dissemination from various weather satellites. This system will provide imagery from the Defense Meteorological Satellite Program (DMSP), from the NASA-NOAA/NESS GOES satellites, from other NOAA/NESS satellites, and from foreign satellite systems as they become available. These data will be sent to AWS CONUS and overseas units in near real time.

Gridded and mapped data will be extracted from disks in accordance with inputs from an operator console associated with the SID support processor. These inputs will trigger the data base processor into accessing the requested data

from disk, performing initial formatting, and routing the data to the SID processor. This processor will perform final formatting and message assembly, and forward the data to users, either through vehicle-dedicated ground stations or on separate dedicated lines directly from the processor.

Raw satellite data can also be sent directly, employing SID console commands. In this case, data are retrieved in real time from data formatter outputs at the vehicle ground station and routed through the SID processor for dissemination to users. In this manner, time is saved and the use of the data base processor is eliminated, but the data are not corrected, mapped or gridded, and appear in relatively crude form.

3.1.3.4 AWN Products (F3400)

A wide range of manually prepared and automated teletype messages will be sent to AWN subscribers over the Carswell line. All data are unclassified, and are routed in real time or are stored in the data base for later extraction and routing.

3.1.3.5 AUTODIN Products (F3500)

Several types of manual, automatic, and computer assisted message products will be generated for transmission to AUTODIN subscribers. (A key message type that will be sent much more frequently in the future is that of Computer Flight Plans.) AUTODIN can now carry messages up to a classification level of Top Secret, and messages will be extracted from the data base by the data base processor and routed for final formatting and transmission on AUTODIN. These procedures will be followed until the Top Secret AUTODIN II system is available (about 1978), when AUTODIN output traffic will be sent to the Datanet 355 for final formatting and dissemination on this new high speed line.

3.1.3.6 Dedicated Circuits (F3600)

AFGWC will continue to serve numerous user agencies on several dedicated KSR, ASR, and high speed lines. In addition, the operational branches of AFGWC itself will receive data from the data system via a number of internal dedicated circuits. These outputs will be initiated directly by data system computers or by a combination of automatic and manual means.

Classification levels of these circuits range from Unclassified to Secret. The techniques of accessing, routing, and transmitting messages over dedicated circuits are basically the same as those discussed for SESS, except that the main processor will, for dedicated circuit outputs, determine the appropriate device to accept these messages, based on the security classification of these data, and route these messages accordingly.

3.1.3.7 WWMCCS (F3700)

In 1978, the WWMCCS Intercomputer Network (WIN) will be operational. The current 2-channel AUTODIN will be replaced by a 4-channel circuit supporting both WWMCCS and the current AUTODIN. AUTODIN will then gradually be phased out, and WWMCCS will be served by what will then be AUTODIN II.

The WIN will be capable of carrying messages through a classification of Top Secret. Output messages for the WIN will thus be sent to the LHDR that will accommodate AUTODIN II (the Datanet 355) for outside dissemination.

3.1.3.8 Special Projects (F3800)

Output communications processing in the special access perimeter will follow the same basic type of data handling scheme indicated for SESS.

3.1.4 Support Processing Functions (F4000)

3.1.4.1 Software Development and Maintenance (F4100)

Software development and maintenance includes those activities necessary to design, write, test, document, and upkeep all input, computational, output, and support processing functions at AFGWC. Most of the tasks involved will be unclassified, low priority, and run in batch mode.

3.1.4.2 Special Studies and Analysis (F4200)

Special studies and analysis functions are confined to the development of new meteorological analysis and forecasting methods and (to a lesser extent) the investigation of new software techniques which will enhance AFGWC computer operations. In this development stage, all such operations are unclassified. These functions are low priority and will access the central data base. Most will run in a batch mode, but some will be scheduled to run routinely as tests and will be time critical.

3.1.4.3 Data System Management (F4300)

Data system management includes the two major functions of network control and quality control. Quality control consists of the policing of AFGWC products to maintain a high level of excellence. It should be present in all functions, primarily in the support area, and in that respect is really tied to all security classifications and hardware components. The proposed network control capability will monitor the status and control the operation of all processors.

3.1.4.4 Real-Time Computer Operations (F4400)

The computer operations included under this heading include unscheduled production, tape handling, console operations, error processing, output data processing, preventive maintenance, processing of interrupts, and error reporting. None of these tasks represent complete functions by themselves. They are steps in more complicated procedures and as such have been covered either implicitly or explicitly by other discussions.

3.1.4.5 Continuity of Operations (F4500)

Certain functions which normally are handled by facilities outside of AFGWC must nevertheless be backed up by AFGWC in case of system failure. The operations involved include those normally performed by Carswell, ETAC, and NWS/NMC. This category also includes the transmission of satellite data to FNWC. To a large extent, these entail a minimum amount of computational processing and a maximum of input and output processing, particularly as it involves communication. ETAC backup is furthermore involved in the archiving of meteorological data, placing a burden on AFGWC's tape drives and library. (It is assumed that a Mass Storage Facility would be of no use for ETAC backup because of the resulting incompatibility between the highly unique nature of AFGWC's recorded data and ETAC's reading devices.)

3.1.4.6 Data Base Construction and Maintenance (F4600)

The manager of the data base will be a central automated monitor who will oversee the attempts to access the data base. This task will be the responsibility of one main processor, but because of the importance of data management to the health of the entire system, an alternate processor will be available at all times to take over the job. Data base management will be an unclassified operation and will occur in the normal access area, although some minor data management (especially as applies to the classified overlays) will be left to all individual processors where the data are used.

3.2 DETAILED FUNCTIONAL PROCEDURES FOR SELECTED AREAS

3.2.1 Input Processing Functions

F1100 SPACE ENVIRONMENTAL SUPPORT SYSTEM DATA (all steps currently performed in System I)

a. Receive data at communications terminal.

b. Decrypt data (DSP, VELA, classified applications only).

c. Buffer and route to printer via RTOS (with operator monitoring).

d. Buffer and route to temporary storage via RTOS.

e. Threshold on key events (by RTOS).

f. Produce and format event messages for transmission on ATN/AWN.

g. Route to raw data file.

h. Initiate validation and decoding by console operator (hourly for ground based data).

i. Store data in processed data file.

j. Route data to printer (with operator monitoring).

k. Produce and format data reports for transmission.

F1200 CONVENTIONAL DATA (currently AWN)

The following steps are currently done on System I:

a. Receive data at communications terminal.

b. Route data to temporary storage.

c. Store data in temporary storage (raw data storage file).

d. Identify data message by MANOP heading.

e. Format messages for decoders and output device.

f. Read in surface/TAF decoding programs and tables as required.

g. Decode surface observations and TAF reports.

h. Route decoded surface and TAF reports to System II.

i. Route raw upper air bulletins to System II.

The following steps are currently done on System II:

j. Route upper air bulletins to Decode File.

k. Read in upper air decode programs.

l. Decode upper air data.

m. Route decoded upper air, surface, and TAF reports to temporary storage files (if required - depends on type of data).

n. Load validation programs.

o. Execute validation programs.

p. Route program outputs to printer or other output device.

q. Accept operator editing and modification inputs as required.

r. Route validated data to regional data base.

s. Store validated data in regional data base.

NOTE: Future functions of Input Processing for Conventional Data:
Route display products/special messages to printer or
AN display (NSSFC, NMC, AFOS products)

F1300 MET-SAT DATA (general)

a. Receive data on "Offutt" link at Site 3 into Data Formatter.

b. Record raw data on magnetic tape.

c. Input operator requests (e.g., data type).

d. Route data to Site 3 display units (raw imagery only).

e. Reformat data as required (analog to digital).

f. Route data to System V.

g. Store data in temporary storage.

F1311 DMSP INPUT DATA PROCESSING

a. The pass schedule is automatically built once a week and with the new schedule the NOVA disk data base is rebuilt.

b. Prior to a particular pass on the schedule, the operator identifies the pass on the schedule.

c. He calls up the pass number via his console.

d. He validates the run setup, including insuring that the data on the CRS scope agrees with the schedule data.

e. He changes status of equipment if required due to problems. This is done by editing of the equipment assignment list through the CRT and accompanying keyboard.

f. He determines what the readout commands must be and he checks to make sure the readout command is correct. The command is actually issued through the NOVA computer at the appropriate time.

g. A sequence card is sent through the NOVA to the 1110 to indicate what data is expected.

h. The operator calls the readout site to see if the on time is correct. The objective is to activate the equipment just prior to data acquisition. There is a pad of about 15 or 20 seconds in this process.

i. Just before the data is received, there is voice communication with the station.

j. Upon sensing acquisition, he hits the shift transfer on his console and the NOVA computer takes over. NOVA automatically configures the equipment.

k. The data is received from Loring and Fairchild tracking stations over a dual 1.334 megabit line. Maximum readout is approximately 12 minutes. This amounts to 200 minutes at tape-recorder speed. The transmission system will be the COMSAT satellite.

l. Frame sync is checked by the data formatter. The data formatter decommutates data between various data types including HRV (2 nautical miles), VHR (1/3 nautical mile), HRIR (2 nautical miles), VHRIR (1/3 nautical mile), and SESS data (including vertical sounding, charge particle counter, lightning counter microwave in 1977, and other classified sources).

m. Data can be written on the tape, displayed, and processed through the OF simultaneously. Presently, only one type of data, the VHR, can be sent to the 1110. By the first of 1976 there will be a second data formatter and therefore two types of data can be read simultaneously.

n. The analog data is written onto a CEC VR3200 tape device. The data that goes to the 1110 has been digitized into 64 gray shades.

o. The operator annotates the analog tape with voice on the third channel.

p. Data is displayed on the weather display racks as it is received from the 1110 computer.

q. Processing by the 1110 is against high resolution data, both IR and video and it includes cleaning, gridding, mapping and computation related to the statistical distribution of gray scales within 25 nautical mile squares on the earth's surface.

r. The data is validated and bad data is thrown out (presently the data base is updated with bad data).

s. Data can be displayed on the digital fax or the police fax. The data from the fax sources can be gridded manually, copied, and distributed. There is a plan to get a second digital display hooked up to the 1110.

t. All data is stored for recall (presently 30 days, but this will be reduced to 7 days). The data is stored on the analog tapes for archival purposes; however a plan is to convert this to drawing digital tapes.

u. The data can be displayed digitally anytime it is available in the disk data base.

v. Processing of secondary data presently requires a replay. The latter can be done simultaneously. It includes application of geography fields against sounding data. Geography fields presently used in the computer are 25 nautical miles resolution, but the data is actually available in 3 nautical mile resolution.

F1411 AUTOMATIC CFP REQUESTS/RESPONSES (currently done in System I)

a. CFP request is received from Autodin at System I.

b. RTOS calls Flight Plan Control (FPC) Program.

c. FPC archives CFP request message for permanent record.

d. FPC stores CFP request in temporary storage.

e. Request is called from temporary storage, FPC decodes requests, validates, determines type and initiates acknowledgement of receipt.

f. FPC routes request to "Request File" (stores request in a queue).

g. FPC produces local output of request on printer.

h. FPC schedules CFP subsystem to process the request:

- Operational Flight Data
- Flight Simulation Model
- Recovery

F1413 MANUAL CFP REQUESTS (currently done in System I).
F1421 MANUAL C&C REQUESTS
F1422 SACCS REQUESTS
F1433 SPECIAL EXERCISE REQUESTS

a. Receive data request from AUTODIN at System I.

b. Route request to 'Request File.'

c. Store in temporary storage 'Request File.'

d. Verify and validate request.

e. Route request to WPF printer for action by WPF.

F1424 WWMCCS INPUT PROCESSING

a. Communications is established on the AUTODIN II network which will also be used as the WWMCCS line.

b. A GWC computer will monitor on a real time basis.

c. Messages coming in will be recognized or sent to the communications console.

d. Protocol will include verification of message received.

e. Message will be checked, single errors corrected, and interpretted for processing.

f. If a request for WWMCCS data base data, a search will begin for the user standard data macros or for the specific data requested by the user.

g. The extraction program will be used to seek out the data.

h. If the message is a request for SDM, the specific parameter sequence is set up based on the input message request and appropriate programs are successor called.

i. When a message first comes in, it is stored in auxiliary memory for recovery.

j. Throughout the processing, the software continues checking, insuring valid processing. If for any reason processing is found to be not valid, the communications console is notified and processing is immediately switched to another configuration using the base message as a start point (unless it can be shown that processing was indeed valid beyond this point).

3.2.2 Data Base and Related Computations Functions

F2100 SPACE ENVIRONMENTAL SUPPORT SYSTEM DATA

a. Program execution control.

b. Process input request.

c. Load program.

d. Input external (non-data base) data.

e. Input data base data.

f. Computation.

g. Program monitoring of execution (by operator).

h. Local output.

F2224 WWMCCS DATA BASE COMPUTATION

a. A set of macro programs are established, keyed off of data type.

b. Incoming data are received from conventional or satellite data sources.

c. The programs are called which validate, process and store the data into the WWMCCS data base. (Note that in the context of GWC design, the "WWMCCS data base" will actually be the data base which facilitates any query response capability.)

d. Processing includes limited graphic capability.

F2231 REQUEST PROCESSING COMPUTATIONS FORECAST CONSTANT GENERATION

a. Prepare card deck.

b. Carry deck to computer center.

c. Remove classified tape from safe and install on computer.

d. Execute model; output local comeback copy on DCT2000 in Command Post (WPF operations).

e. Transmit data to user.

f. Remove tape and replace in safe.

g. Retrieve card deck and return.

F2232 REQUEST PROCESSING COMPUTATIONS – FORWARD TRAJECTORY MODEL

a. Prepare card deck.

b. Submit (handcarry) to computer center.

c. Computer operator submits to computer for execution.

d. Execute FTM program; output local comeback copy on DCT2000 in GFO[1].

e. Card deck returned to GFO[1] courier.

f. Card deck returned to current operations file by GFO[1] courier.

[1]Now part of WPF.

F2320 UPPER AIR ANALYSIS

a. Call up Analysis Program (Macro scale or Fine Mesh Upper Air Analysis Models).

b. Input validated upper air data reports (Height, Temperature, Wind).

c. Input 'First Guess' data fields (blend gridded data from Northern Hemisphere into tropical best-guess field).

d. Compute Scan Radius (in Fine Mesh model).

e. Scan grid points in circular area about observation point and compute difference between 'reported' and interpolated 'best guess values.'

f. Store difference (correction) data values by grid point.

g. Sum corrections for each grid point and add total correction to Best Guess values.

h. Repeat steps d through f as required (3 times for fine mesh -- 3 to 4 times for macroscale).

i. Produce (compute) final analysis field.

j. Compute and make adjustments to analysis field (smoothing, vorticity, wind shear, etc.)

k. Store analysis fields in Data Base.

F2330 SATELLITE DATA PROCESSING

a. Input parameters which describe data bench line (eleven values: line number, Julian time, latitude of subpoint, etc.).

b. Determine scan planes (from bench line parameters).

c. Locate map bench point between scan planes.

d. Determine interpolation value from perpendicular distance from point to planes.

e. Determine through interpolation the line value for the Map Bench Point.

f. Calculate sample value (IR or Video) for the Map Bench Point.

g. Store sample value (character value) for Bench Point in Mapped Data File.

h. Repeat process for each Map Bench Point and produce updated Mapped Data File.

F2340 3DNEPH COMPUTATIONS (SEE FLOW CHART)

a. Determine data status by window (or block) (and output data status to computer operator if decision is required).

b. Call up 'Surface Data Processor' routine.

c. Input 1/8 mesh terrain model.

d. Input validated surface data for window.

e. Compute "total cloud amount" and amount of cloud for each of 15 layers (8 functions for each data report).

f. Store computed data from 'Surface Data Processor' for use in 'Decision Tree Processor' routine.

g. Call up 'Raob Data Processor' routine.

h. Input validated raob data for window.

i. Compute cloud amounts for each of 15 layers (using 1/8 mesh terrain field).

j. Store computed data from 'Raob Data Processor' for use in "Decision Tree Processor."

k. Call up "Aircraft Data Processor" routine.

l. Input validated aircraft data reports.

m. Compute 'total cloud amounts' and amounts of cloud by layer for each of 15 layers (using 1/8 mesh grid).

n. Store computed data from 'Aircraft Data Processor' for use in 'Decision Tree Processor routine.'

o. Call up 'Manual Data Processor.'

p. Output analyzed data to monitoring analyst upon request.

q. Accept input of new or corrected data from analyst.

r. Compute 15-layer cloud report for every 1/8 mesh grid point.

s. Repeat steps a through r for each window.

t. Sort merge and store data for use in "Decision Tree Processor."

u. Call up "Decision Tree Processor" routine.

v. Input data from the four (4) previous routines.

w. Integrate all cloud data into decision process.

x. Compute "Best Report" of total cloud, and cloud by each of 15 layers.

y. Store computed cloud data in "Best Reports File."

z. Call up "Satellite Video Data Processor" routine.

aa. Input Minimum Brightness Field.

bb. Input rectified and normalized satellite video data.

cc. Compute digitized cloud data from raw video data (for 1/8 mesh grid).

dd. Compute updated Background Brightness field

ee. Store updated Brightness field.

ff. Rank satellite video data according to timeliness and data source (vs surface report) in decision process.

gg. Produce mosaic of total cloud cover.

hh. Store cloud mosaic data for use in 'Final Processor.'

ii. Call up 'Satellite IR Data Processor' Routine.

jj. Input rectified IR Data.

kk. Input related data fields for use in analysis (surface data and upper air).

ll. Compute digitized cloud cover data from raw IR data (1/8 mesh grid).

mm. Rank satellite IR data according to timeliness and availability of satellite video data for decision process.

nn. Store data from Satellite IR Data Processor for use in Final Processor.

oo. Call up Final Processor.

pp. Input data from Continuity Cloud Field.

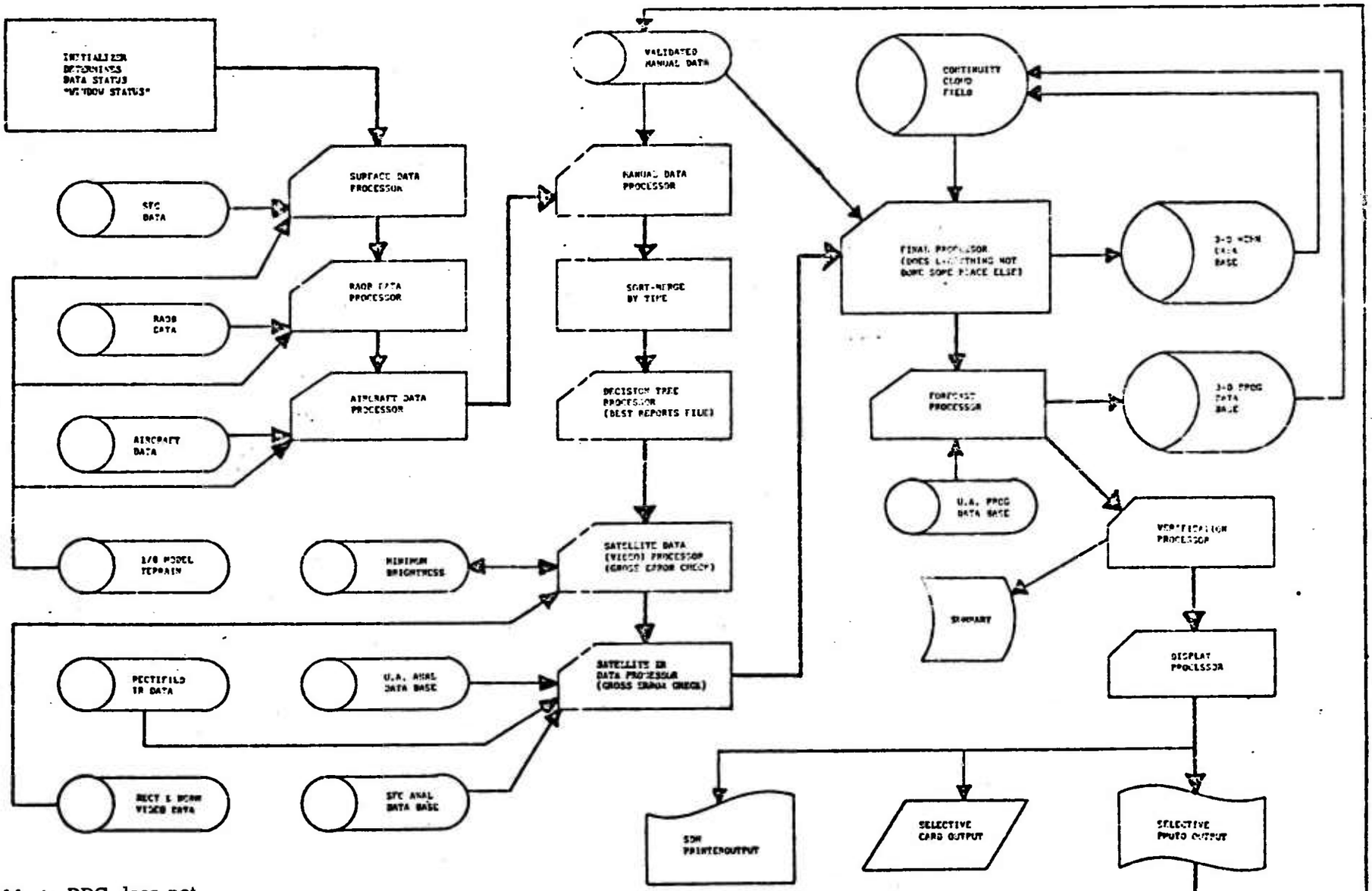
qq. Input data fields from previous routines (Decision Tree Processor and Satellite Data Processors).

rr. Input validated manual data as applicable for change or correction (analyst interface as required).

ss. Compare and weigh data inputs for logical decision process.

tt. Determine total cloud amounts, cloud types, and amounts for each of 15 layers.

uu. Store cloud data in 3DNEPH Data Base.



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30NEPH PROGRAM FLOW.

F2352 SNOW ANALYSES

a. Call up general purpose grid analysis routine.

b. Access Data Base containing validated surface data.

c. Input reported values of snow depth.

d. Produce gridded field of snow depth.

e. Store snow depth field in data base.

F2410 GENERAL PURPOSE FIELD FORECASTS

a. Call up Forecast Model.

b. Input pressure-height analysis data from GWC data base.

c. Compute stream functions.

d. Store stream functions values for subsequent use.

e. Call stream functions values from storage and compute vertical velocities by layers.

f. Compute stream functions tendency (using vertical velocities and computed stream functions).

g. Compute stream function forecasts.

h. Produce forecast fields of vertical velocity, wind and temperature.

i. Store forecast fields in GWC data base.

Forecast fields packed in 1/2 word format, wind forecast fields are stored for every 2 hours out to 60 hours, then at 72 hours. Heights and temperature fields for every 6 hours out to 48 hours, then at 60 hours, and 72 hours.

} Macroscale 6 Level Model 572 Packed fields for 72-hour forecast

Mesoscale Prediction Model (Window) — Program contains 6000 lines of coding (FORTRAN V) - Runs each 12 hours, requires 8 min CPU time to produce 24 hour forecast - utilizes 55000 core locations in each of 3 segments of execution. Stored in data base in 1448 word formats - wind components every hour, temperature and height fields every 3 hours.

Tropical - Not as rigorous - same basic differences - 5 min - CPU time (1108) for 48 hour forecast.

F2420 SPECIAL PURPOSE FIELD FORECASTS

a. Input analysis field from data base.

b. Input general purpose prognosis field as applicable (e.g., U.A. Prog. Data for 3DNEPH forecast model).

c. Call up special purpose forecast model.

d. Compute special purpose field.

e. Store computed data in prognosis data base.

F2430 BOUNDARY LAYER MODEL FORECAST (See Flow Chart)

a. Call up Boundary Layer Analysis Model (6 programs).

b. Input fixed field data, upper air and surface data, and mesoscale analysis fields (sequentially, as required in step 'c' for execution of analysis programs).

c. Execute analysis programs and establish arrays for prognostic model:

1. Check data base for presence of data to execute model.

2. Compute fields of specific humidity, temperature and specific humidity lapse rates for use as first guess fields in temporary storage.

3. Compute height values, temperatures and humidity for each level of model, store data for subsequent use.

4. Produce analyses of temperatures and specific humidity for each level of the model.

5. Integrate analysis fields, fixed fields, and cloud data into arrays for forecast model; store for subsequent use.

6. Interpolate analysis and 24-hour forecasts of U and V components of wind; pack into arrays, store for use in prognostic model.

d. Call up Boundary Layer Prognostic Model.

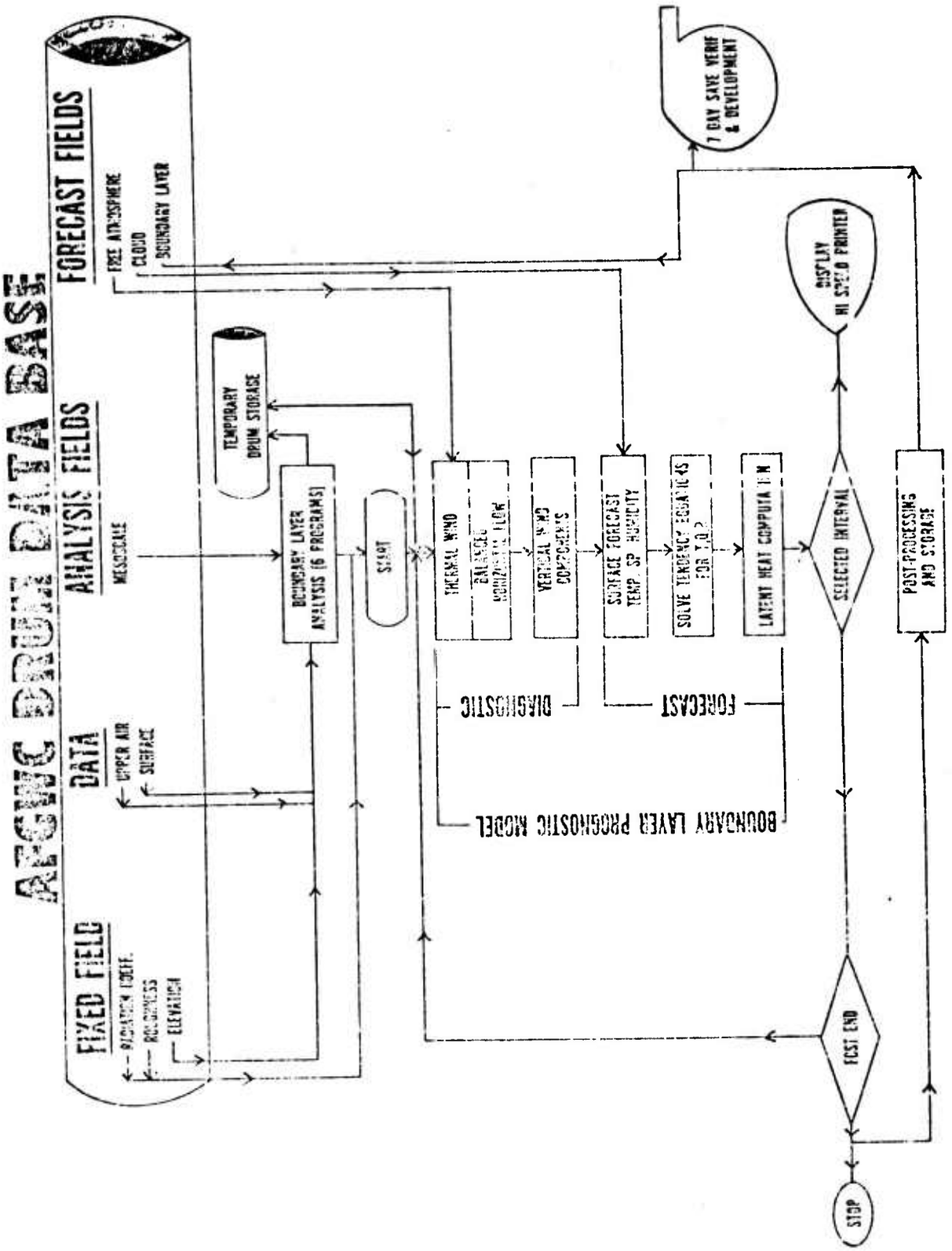
e. Input initial conditions (data arrays for analysis model, forecast fields) from temporary storage.

f. Perform diagnostic computations to produce geostrophic winds and vertical wind components.

g. Input cloud forecast field.

h. Compute forecast fields of 1600m D-values, wind components, temperature, humidity, cloud forecasts, etc.

i. Store output data (see Table Attached) at hourly forecast intervals in GWC data base.



FLOW DIAGRAM OF OPERATIONAL BOUNDARY LAYER MODEL

3.2.3 Output Processing Functions

F3110 MANUAL AND COMPUTER ASSISTED SESS OUTPUTS

a. Accumulate data, sort TTY information.

b. Review data:

   1. ask for more via card deck, through "hole in wall" record information on printer;

   2. analyze data (phone if required).

c. Type message, punch paper tape, or punch cards.

d. TWX or card deck to computer.

e. Come back copy - ATN product returned on AWN.

F3120 AUTOMATIC (COMPUTER DRIVEN) SESS PRODUCTS

a. Automated products released.

b. Forecaster accumulates data, sorts TTY information.

c. Review data:

1. Correct incorrect data through ATN or by card deck.

2. Request additional information if required:

a) card deck,
b) receive on printer.

3. Analyze data.

d. Prepare computer input - card deck or paper tape for ATN (HMUS 1, 2).

e. Card deck input through "hole in wall".

f. Come back copies:

1. Printer,
2. DCT,
3. 1004 in computer room back through "hole in wall", and
4. Punched cards.

g. 1004 copy mailed if required.

h. Punch cards validated, interpreted and mailed.

F3700 WWMCCS DATA OUTPUT PROCESSING

a. Once the data has been identified and located in the data base, and the buffer area for results of computation is identified, the output processing programs are called.

b. Data are formatted for output, security level is established, and validity check is made to insure compatibility between recipient and message.

c. Message logging and timing is accomplsiehd.

d. If specified, hard copy results are stored for output.

e. Communications is established through appropriate protocol.

f. Message is transmitted. Verification is awaited.

3.2.4 Support Processing Functions

F4310 DATA SYSTEM MANAGEMENT – NETWORK CONTROL FUNCTION

a. Prepare and update standard task frequency table.

b. Insert special task times.

c. Run task schedule routine.

d. Identify action if task requirement not met.

e. Identify task/event relationships.

f. Identify task priorities.

g. Identify task/resource matrix.

h. Identify threshold criterion for task activation.

i. Identify criteria for query frequency/times.

j. Identify maintenance schedule.

k. Enter maintenance into queue.

l. Determine event/time relationships where this a priori relationship can be established.

m. Associate event activated tasks with a time and enter into priority ordered queue.

n. Query unpredictable events to see if associated tasks are to be exercised.

o. Process any queries and enter in priority ordered queue.

p. Terminate tasks which have been bumped by priority.

q. Take appropriate action for bumped tasks (e.g., reenter into task queue).

r. Initiate task process when resources are available.

s. Monitor data base status.

t. Monitor resource integrity.

u. Monitor task processing.

v. Sense processing abnormalities.

w. Respond to abnormalities by manually adjusting the queue.

x. Force resource scheduling if required.

F4320 DATA SYSTEM MANAGEMENT — QUALITY CONTROL FUNCTION

a. Build forecast vs forecaster file.

b. Obtain Computer Flight Plan vs Actual Flight Data File (currently from MAC Form 193 Flight Folder Information but potentially it could be added to the arrival message AM-2 MAC information system).

c. Monitor message transmission vs transmission requirement and record deltas.

d. Generate statistics on output timeliness.

e. Input verified data as required.

f. Compare forecast data against current analysis[1] data.

g. Generate comparison statistics.

h. Compare Flight Plan vs Actual Flight Data.

i. Generate comparison statistics.

j. Observe wind and pressure analysis charts overlayed on forecasts and score differences.

k. Update quality assurance results data.

l. Generate monthly internal and external summaries.

m. Generate annual summary.

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[1]Techniques are required for analysis validation

F4410 UNSCHEDULED PRODUCTION

a. Job is submitted into the system (WPF, SESS, Development).

b. Job is logged into Job Control (unless classified in which case logging is performed by system operations).

c. Necessary tapes etc. are obtained to support job.

d. Unclassified jobs can be input to the computer through the remote 1004 system.

e. Deck is returned or submitted for return to the originator along with a listing.

f. RTOS processes the job and places in the product file.

g. RTOS performs a security check against customer, any lines that are involved and whether the classification is proper.

h. The executive executes the job.

F4420 TAPE HANDLING (Disk Packs are not used like tapes)

a. All tapes (except for rare exceptions) are in the tape library.

b. The Forecast Constant Generation Program is handled by operator and operator from the GFO section.

c. Job request designates tapes to be used.

d. Tape Librarian supplies tape(s) associated with job.

e. Individual is assigned to miscellaneous tasks such as mounting tapes. Depending on workload (e.g., production vs operational) a single person may perform this function on one or more systems.

f. Tapes are addressed to physical units within a program. The only way to alter tape drive for a given program is through "repatching" of a plugboard.

g. If the tape is not mounted by the time the program is executed the operator is notified and the computer awaits the appropriate action.

h. Tapes written during a run are labelled and logged back into the library.

i. Few or no cases of manual tape handling during the middle of a run exist.

F4430 CONSOLE OPERATIONS

a. The operator console consists of a CRT hardcopy device, one alpha-numeric keyboard, and status information via lights.

b. All messages from the computer to the operator arrive on the CRT and hardcopy device.

c. Classified job requests require a password if the program is not preloaded in the classified program file.

d. The System Duty Officer must personally identify the person requesting the run and then will enter the password associated with the request.

e. The key is compared against a classified password match code entered at system autoload time.

f. System I operator has no indication that remote entries have been made from the 1004 unless he checks the job queue.

g. When running the Forecast Constant Generation Program (FCGP) the operator must jointly handle classified tape with operator from WPF to conform with regulation.

F4440 ERROR PROCESSING

a. Program errors may show up on the operator CRT.

b. The way of presenting the error depends on who wrote the program.

c. Error identification and continue; error identification and operator action request; and also abort are all possibilities in error reporting.

d. Job number is identified with error.

e. Errors may require action by someone other than the operator (e.g., person submitting run). If this is the case the operator makes a telephone call.

f. In the case of an abort, since successive programs communicate primarily by disk, very little is affected other than current programs.

g. New programs are immediately loaded and processing continues.

h. The operator option exists to obtain a post mortem dump (as long as it is allowed for by the program).

i. The dump is entered into the output processing queue.

F4450 OUTPUT DATA PROCESSING

a. High speed printer output is separated and marked.

b. Printer output is buffered via disk.

c. Printer output is given in a mixed first ready-first out/priority scheme.

d. 4 high speed printers in Systems I-II-IV.

e. Maximum of two (2) high speed printers per system.

f. Printer output is on 1-ply paper.

g. Special map or gridded paper is occasionally used.

h. System is used as off-line printer system a couple of times a month.

i. On operator option, the printout output can be written onto tape and output on another system or saved until later output.

j. Output is immediately hand delivered or via 3-hr distribution depending on classification/priority.

k. Printer output does not in general contain status information but rather the end result of computation.

F4460 PREVENTIVE MAINTENANCE

a. The 1108 systems (I through IV) have preventive maintenance (PM) performed every two weeks. The 1110 system (V) has preventive maintenance performed every week.

b. PM is performed by UNIVAC and involves detailed checking of electronics both with equipment and diagnostic software.

c. The operator has the daily task of certain cleaning and adjustment functions including cleaning the tape heads.

d. UNIVAC PMs attempt to isolate hardware problems that are indicated in resent problem report history, based on analysis of error reports that were not deadly to the system.

F4470 INTERRUPT PROCESSING

a. To interrupt the executing job, it must be aborted by operator action.

b. If a job is aborted all capacity to restart at interrupt point is lost. Job must make a virgin restart.

F4480 ERROR REPORTING

SOFTWARE

a. Errors are limited to operations problems.

b. Errors are noted on software error forms.

c. Attached to forms are core dumps (typewriter output).

d. Reports are analyzed by WPD central analyst and distributed to appropriate programming group or groups.

HARDWARE

a. System operators note problem on hardware error report form.

b. UNIVAC responds to report with on site field engineers.

F4510 CONTINUITY OF OPERATIONS — ETAC BACKUP

NORMAL OPERATIONS (ETAC OPERATIONAL)

a. Receive daily ETAC climatological data base update from ETAC via dedicated communication link (current communications are via the NWS National Distribution Circuit).

b. Temporarily store ETAC update data in mass storage.

c. Perform update of AFGWC maintained ETAC climatological data base stored on magnetic tapes.

CONTINGENCY OPERATIONS (ETAC INOPERATIVE)

Twelve hours following notification that ETAC is inoperative:

a. Identify the existing ETAC climatological tape stored data base as Day No. 1. Remove and physically store all day No. 1 tapes.

b. Mount new blank ETAC magnetic tapes.

c. Load ETAC Operational Programs.

d. Perform computations with ETAC Operational Programs and GWC Global Data Base to generate new ETAC climatological data base. (Requires approximately 6 hours per day.)

e. Transfer new ETAC climatological data base to magnetic tape mounted in Step (b). Label as tape No. N+1 with N= to number of ETAC data bases previously stored.

f. Perform steps (b) through (e) daily for the period of time the ETAC facility is inoperative but with a limit of N = 90.

Within six hours following notification that ETAC has resumed operation:

a. Send via the dedicated ETAC to AFGWC communications link all accumulated daily ETAC climatological data bases.

b. Following acknowledgement from ETAC that the daily data base data has been received, remove the N number identification from the last AFGWC data base produced, and identify as the current AFGWC maintained ETAC climatological data base. Purge all other magnetic tapes containing ETAC data base data.

c. Return to NORMAL OPERATIONS.

F4520 CONTINUITY OF OPERATIONS – CARSWELL BACKUP

These procedures assume a total functional backup of all Carswell operations with no change in AFGWC basic operations. It is assumed that input, product computation and output data processsing facilities equivalent to those located at Carswell are available on a standby or interruptable basis at AFGWC.

a. Immediately following notification that the Carswell facility has become inoperative, initiate AWN data collection. If input processors assigned to Carswell backup are in use, interrupt operation and load AWN decoder programs and initiate operation. If Carswell assigned input processor is in standby mode, AWN decoder programs will be in core.

b. Initiate Carswell product computation and output scheduleing on the computational facilities assigned for Carswell backup. If these facilities are in use, interrupt and load the Carswell backup scheduling and operational programs and initiate operations. If the Carswell backup assigned facilities are in a standby mode, the scheduling and computaional program will be in core.

c. Operate the Carswell backup functions concurrent with AFGWC operations for the duration of the Carswell outage.

d. Following notification that Carswell has returned to full operational status, discontinue backup operations and return facilities to standby or low priority usage.